Wildfire Patterns Change in Central Idaho's Ponderosa Pine–Douglas-fir Forest

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*ABSTRACT. Study of long-term fire histories (from fire scars on old trees) helps determine if severe fires were characteristic of the ponderosa pine (*Pinus ponderosa*) forests in central Idaho before the arrival of Euroamericans. Before 1895, all sample sites had average fire intervals of 10 to 22 years, implying a pattern of light to moderate surface fire. After 1895, fire intervals lengthened considerably, and severe fires became relatively common. Factors apparently influencing this change were a reduction in uncontrolled fires started by American Indians and Euroamericans; heavy livestock grazing that removed fine fuels; establishment of a fire suppression program; accumulation of slash from early logging; and development of dense conifer understories (ladder fuels). Applications of prescribed burning might reduce the risk of severe wildfires.*

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In west-central Idaho, severe wildfires have destroyed thousands of acres of ponderosa pine–Douglas-fir forests (*Pinus ponderosa-Pseudotsuga menziesii*) since the early 1930s (Conaughton 1936, Wellner 1970, Smith 1983). Yet studies of fire history in similar forest types (Martin 1982) suggest that a pattern of destructive fires was not typical in the western United States prior to settlement by Euroamericans. In these other ponderosa pine–fir forests, fires commonly occurred at average intervals of 5 to 20 years, which suggests a pattern of surface fire and raises the question of what were the presettlement fire intervals in west-central Idaho.

In the course of studying the role of fire in succession and possible applications of prescribed fire in the ponderosa pine–fir forests (sometimes also including grand fir [*Abies grandis*]) of central Idaho, we were hampered by the lack of information on long-term fire history. Despite the small amount of time and money available, it seemed possible to overcome this deficiency in ecological knowledge by making a limited investigation of fire history. For our study area we chose the Boise Basin country because of its easy access and recent history of severe wildfires.

Boise Basin is centered about 25 air miles northeast of Boise, Idaho. High ridges rim the basin on three sides forming the Mores Creek–Grimes Creek drainage, which flows mainly to the southwest. The central portion consists of gently rolling hills, now covered mostly with young conifers and shrubfields. In the 1860s this area was the focus of intensive gold mining. One of the towns, Idaho City, was briefly the largest city in the Northwest (Smith 1983).

Surrounding the basin's gentle terrain is a matrix of steep and sharply dissected topography. Ponderosa pine of various sizes grows throughout the area along with Douglas-fir that in some places forms dense understory thickets. Within this young forest, one finds occasional large old ponderosa pines, remnants of previous forests that were logged or burned.

Some of these pines experienced a surface fire at an early age, before their protective bark had become thick. The fire often scarred the bases of these young pines, but the trees survived and continued to grow. Subsequent fires sometimes caused a new scar, which would begin to heal the following spring. The approximate age of each scar is revealed by the number of annual growth rings produced since that event. Today, some of these large pines bear the scars of many fires, most of which predate written records.

METHODS

To sample fire history, we selected seven sites for their dispersion across the Boise Basin and the presence of large relict pines. We made an intensive inspection of the fire scars on old trees and stumps in perhaps 10 to 20 acres of each site. Then we chose one to three trees per site that appeared to have the best preserved and most complete sequence of fire scars as indicated by the folds of healing tissue on the charred stem. We used the sampling and analysis techniques recommended by Arno and Sneck (1977).

We selected 14 trees from the seven sites, and from each tree we carefully chain-sawed a cross-section of the multiple fire scar. Because most of the extracted cross-section is nonliving and is taken from a previously scarred area, the additional injury to these pitch-filled pines is not great. About 10 to 15% of the tree's cross-section is usually severed.

After sanding the cross-sections to a polished surface, we dated each fire by counting the annual growth rings between each scar and the living cambium. Pockets of decay, pitch that obscured the rings, and extremely slow growth (sometimes following fire injury) complicated the scar dating process. Still, it was not difficult to identify similar fire years among trees on the same site and to develop a master fire chronology (Arno and Sneck 1977) for each site (Figure 1). More precision in defining individual fire years could have been achieved, at considerable expense, through dendrochronological cross-dating (Madany et al. 1983), but such precision was not deemed necessary for identifying the general frequencies of past fires (McBride 1983).

RESULTS

All of the sample stands experienced frequent fires prior to 1895 (Figure 1). Before 1700, records are sketchy because of a scarcity of sufficiently old fire-recording trees and the likelihood that some of the earliest scars were destroyed by later fires. Between 1700 and 1895, mean fire intervals in the sample stands ranged from 10 to 22 years.

When these stands are arranged on a dry to moist gradient using habitat

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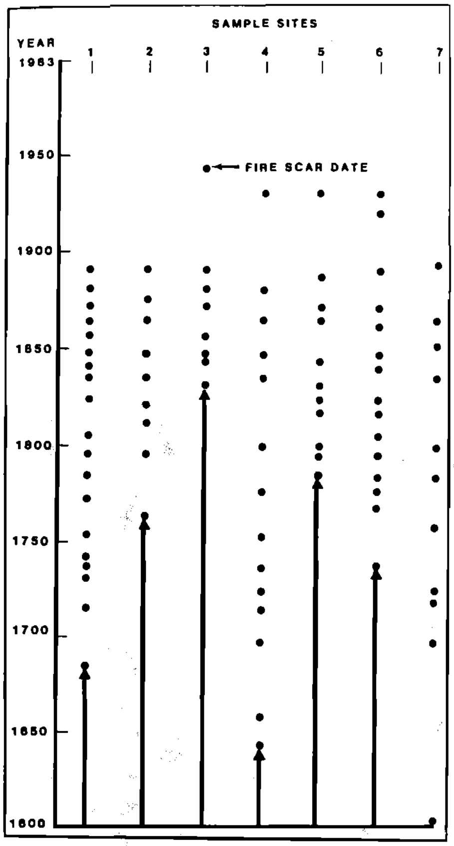

Fig. 1. Master chronology of fire history for seven sites in the Boise Basin. Arrows indicate the beginning of fire records at each site.

types, based on potential vegetation (Steele et al. 1981), the mean fire intervals increase with site moisture (Table 1). Stand 4, which contradicts this gradient, occurs directly upslope from a stream terrace and thus presumably is less vulnerable to spreading fire than the other stands, which all occupy mid- to upper-slope positions. Although stand 5 is the driest site based on habitat types, it is surrounded by much wetter sites, which may explain its small deviation from the gradient of mean fire intervals.

Table 1 suggests in a general sense that the dry, low-elevation sites burned at intervals averaging about 10 to 13 years, while moist, high-elevation ponderosa pine–Douglas-fir sites burned at averages of 16 to 22 years. Any of the sites may have actually burned somewhat more frequently than our data indicate because one or more fires may have failed to scar the sample trees. Nevertheless, fires occurring at the intervals indicated in our data generally would have resulted in open parklike stands of ponderosa pine with light fuel loadings similar to those illustrated by Gruell et al. (1982) in western Montana. Ten times between 1700 and 1891, most of our sample sites recorded fires in what appear to be the same years, suggesting that individual fires may have covered large areas, or many fires burned in the same year.

DISCUSSION

Lightning is well recognized as a major cause of historic and modern fires in west-central Idaho. However, little attention is paid to the possibly major role of American Indians in starting fires prior to the mining era. Up until the 1860s various Shoshoni groups inhabited central Idaho (Smith 1983). As a general practice, Indians in western North America used fire for many reasons such as forage and berry crop improvement, campsite maintenance, communication, game drives, warfare tactics, and even amusement. Because the Indians had little reason or capability to put out wildfires, both deliberate and accidental ignitions burned until extinguished by weather or fuel conditions (Gruell 1985a, Lewis 1985).

Gruell (1985b) summarized several reports documenting Indian fires throughout the lower elevations of central and southern Idaho. Captain Wyeth, for instance, who traveled through that area in 1834 (Young 1899), mentions Indian-caused fires, some of which were quite extensive. The gentle terrain of the Boise Basin provided good campsites and likely experienced Indian fires that spread onto adjacent steeper terrain.

As settlers and miners began displacing the Indians during the 1860s, human-caused fires continued to be common. Settlers used fire to clear the land, and miners may have set fires to expose mineral outcrops. Early loggers left large quantities of slash lying in the forest, which added greatly to fuel loadings and fire hazard.

After 1891, the fire frequency recorded in our tree scars changed (Figure 1). Fire intervals lengthened, which would have allowed more dead and living (ladder) fuels to accumulate in these relatively dry forest types (Dodge 1972, Davis et al. 1980). Several subsequent fires became major conflagrations that killed even the large pines that had survived other fires for centuries.

A pronounced lengthening of fire intervals after the late 1800s has been noted in ponderosa pine forests throughout much of western North America (Arno 1976, Stokes and Dieterich 1980, Martin 1982). In the Boise Basin, as in many other regions, three factors probably contributed to the diminishing frequency of fire in ponderosa pine forests: (1) Smaller numbers of human-caused fires may have occurred after 1900 because most Indians were living on reservations, and settlers were becoming aware of a need for fire control to save buildings and standing timber; (2) organized fire suppression began in 1905 in central Idaho, and in 1908 two fire lookouts were built in the Boise Basin (Smith 1983); (3) unregulated livestock grazing became widespread in central Idaho in the late 1800s, removing a large proportion of the grass and other light fuels needed for ignition and initial spread of fire.

The trend toward fewer fires, many of which were likely surface fires, may have enhanced the risk of crown fires. Increasingly long periods without fire would have allowed a layer of understory conifers to develop in formerly open stands (Cooper 1960, West 1969, Hall 1976, Gruell et al. 1982). This understory could become the ladder fuel that would allow fires to crown more readily. Understory thickening may have been enhanced when heavy grazing left soil exposed (receptive to tree regeneration) and was then followed by a reduction in grazing levels (Rummel 1951, Zimmerman and Neuenschwander 1984). In the late 1800s and early 1900s, most logging operations removed only the best trees and left large quantities of untreated slash in residual stands. The small openings that were created often became filled with dense patches of saplings and poles, again increasing ladder fuels and the risk of crown fire.

Severe drought has been recognized as a major factor in some of the catastrophic fires that burned in west-cen-

Table 1. Mean fire interval of sampled stands arranged on a dry-to-moist gradient using habitat types.

Stand no.	Elevation (ft)	Habitat type (potential climax)	Mean fire interval (1700 to 1895) (yr)
5	5,625	Ponderosa pine/mountain snowberry	11.4
3	5,000	Douglas-fir/elk sedge	9.8
1	4,600	Douglas-fir/white spirea	10.3
4	4,975	Douglas-fir/white spirea	18.1
6	4,850	Douglas-fir/ninebark (dry extreme)	12.8
2	5,820	Douglas-fir/ninebark (typical condition)	15.9
7	5,600	Douglas-fir/ninebark (moist extreme)	21.7

tral Idaho during this century (Wellner 1970). The prime example of this is the exceptional drought of 1931, when May to August precipitation at Idaho City was only 5% of normal, which was accompanied by the devastating Quartzburg (40,000 acres) and Macks Creek (22,000 acres) fires.

Even in presettlement times, severe drought coupled with high winds and ignition must have sometimes resulted in crown fires in central Idaho's ponderosa pine–fir forests. Although these fires may have been recorded by our sampled trees, they cannot be distinguished from the surface fires. For instance, the widespread Quartzburg fire is recorded by three of our sample trees (Figure 1) but apparently was not a crown fire at those points on the landscape. Although we cannot determine the percentage of presettlement crown fire to surface fire, it seems reasonable that a fire frequency of 10 to 20 years maintained low fuel levels and consisted mainly of surface fires in ponderosa pine–fir forests. This concept is consistent with evidence from other studies (Arno 1976, Martin 1982) where stands of old trees and stumps covered the landscape in areas that had short fire intervals for several centuries. In the past few years throughout central Idaho we have observed ponderosa pines with multiple fire-scar sequences that resemble the findings from the Boise Basin (Figure 1). This widespread evidence suggests that most ponderosa pine–fir forests of central Idaho experienced the high fire frequency characteristic of a surface fire pattern.

Many stands in the ponderosa pine–fir type in central Idaho, and elsewhere in the western United States, a dense growth of young conifers and shrubs, or dense patches of understory conifers beneath mature trees. Such stands may also have a thick layer of pine needle litter and duff; and by down woody fuels, like old logging slash. These situations contain the fuel ladders that increase the risk of crown fires. In contrast, the frequently burned open stands of pre-1900 would have been less susceptible to development of crown fires (Biswell 1977).

Improved slash disposal, clear cutting, road building, and improved fire suppression capabilities have apparently reduced acreages burned on the Boise National Forest during most years (Smith 1983) and have prolonged the average fire intervals in most stands. Paradoxically, this reduction of fire in ponderosa pine–fir forests often leads to an increase in dead and living fuels, which enhance the risk of severe fire (van Wagtendonk 1985). For many management situations this may be an unavoidable consequence of increasing timber production.

For some situations in the ponderosa pine–Douglas-fir type, the fire history suggests that prescribed underburning would be useful. For example, underburning could be carried out in conjunction with timber harvest in shelterwood systems, in maintenance of even-age stands, with mechanical thinning (Martin and Dell 1978, Barrett 1979, Burns 1983), and possibly with group selection systems (Curtis and Wilson 1958, Cooper 1960, 1961, Weaver 1967). Kilgore and Curtis (1985) have prepared a publication on the status of understory burning in the inland Northwest. They found that during 1983, more than 12,000 acres of such burning in ponderosa pine was accomplished on 12 ranger districts with active burning programs. Site-specific fire prescriptions still need testing and careful documentation. Yet prescribed burning coupled with harvesting could be designed as a substitute for the frequent surface fires of presettlement times, which reduced fuel loadings and helped prevent the more destructive fires of recent years.

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